Seeing Faraway Things as Though Nearby

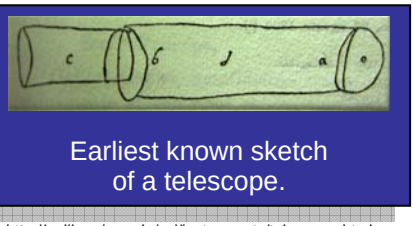
The work of early scientists like Copernicus (see “Thinking Outside the Box”), Brahe, and Kepler (see “Between Jupiter and Mars”) was extraordinary in that all their observations were made using only their human eyes. The invention of the telescope, a technological breakthrough, allowed scientists to “extend their senses.”

So Who Invented the Telescope?

The story is told that it was two little children who were playing with lenses in the shop of **Hans Lippershey**, a reading glasses or spectacle-maker in Holland. The children held two lenses together and saw that the weather vane on a nearby church became larger and more well-defined. The rest of the story is that Lippershey then tried it himself. He put a tube in between the two lenses and the prototype of the modern scientific instrument was invented. It was probably an inch and one half or less in **aperture** *(the diameter of an opening in a lens)* with 3 or 4 power magnification. For instance, a marble magnified to appear 3 or 4 times larger than its actual size may look the size of a ping-pong ball.

The telescopes available today have magnification powers that can range well into the hundreds.

If Lippershey was not the actual inventor, he was at least the first person to try to market it. In 1608, he applied to the Belgian government in The Hague for a **patent** on a device using multiple lenses. The patenting procedure *(like a trademark or copyright that protects an individual’s idea from being duplicated by another person)* at that time required the applicant to make three identical devices and to keep his method a secret. The first requirement was not a problem for him, but the latter requirement proved impossible for Lippershey. A short time later, **Jacob Metius of Alkmaar**, applied to the same government office for a patent on a device for "seeing faraway things as though nearby." His device consisted of a **convex** *(curved outward)* and **concave** *(curved inward)* lens in a tube and magnified an object three or four times. These early devices more closely resembled our modern day “spyglasses” than our modern telescopes.



Earliest known sketch of a telescope.

http://galileo.rice.edu/sci/instruments/telescope.html

At this point, there are two different versions of the government’s patent board decision. One version has it that they turned down Metius’ application, at which time he became very possessive of his telescope and showed it to no one. It is said that even the tools that he used to make it were destroyed after he died.

The other version of the story says that government officials discussed the patent applications of both Lippershey and Metius. They thought that the device was too easy to copy to patent, so they gave

small financial award to Metius and paid Lippershey “handsomely” to make several copies of his device.

Galileo Received Undo Credit for the Refractor Telescope

It wasn’t until July of 1609 that **Galileo Galilei** heard a rumor that Lippershey was on his way to Venice to sell his invention “that made distant objects seem near” to the Venetian state. Galileo was in need of money, and the Venetians were offering Lippershey a high price for his device, so in 24 hours Galileo had a telescope made and sent word of “his invention” to a monk in a high office of the Venetian state. For this, Galileo received a raise in salary from 520 to 1000 florins per year.

Whatever the truth of these stories, two things are certain. One, the first telescopes were *not* invented by scientists, but by craftsman; and two, the telescope was *not* invented by Galileo.

http://astro.uchicago.edu/vtour/40inch/

The 40-inch refractor at the Yerkes Observatory set out to be the largest telescope in the world when construction began in 1890. Today, it still is the largest. A special dome and floor had to be custom built for the telescope.

What is also true is that telescopes revolutionized astronomical observation, and scientists depended upon larger and better telescopes to advance their study of the universe. Galileo used the **refractor telescopes** he constructed to discover the satellites of Jupiter, the rings of Saturn, the changing shape of Venus, sunspots and solar rotation in less than ten years. There is recorded evidence that, in the same decade, at least ten other astronomers built their own refractor telescopes using different combinations and types of lenses. Many of these were used to corroborate, support, and extend Galileo’s discoveries.

Isaac Newton and the Reflector Telescope

The English mathematician and physicist, **Isaac Newton**, was one of the first scientists to construct a two-metal-mirrored **reflector telescope** in 1668. Some of the best reflector telescopes were designed and constructed by **William Hershel**, a musician turned observational astronomer. He built a telescope that was used by **Johann Schröter**, a minor official in the Hanoverian suburb of Lilienthal. Johann Schröter was elected president of the *Societas Lilientalica*, sometimes called the **Celestial Police**, formed for the expressed purpose of discovering the "missing planet” predicted by **Bode's Law** between the orbits of Mars and Jupiter. See the Activity, “In Search Of…,” to see how the Celestial Police carried out their investigations.

Additional Resources

Web Sites

http://astro.uchicago.edu/vtour/
Take a virtual tour of the 100-year old Yerkes Observatory at the University of Chicago. See and learn about the five research telescopes used at the observatory, including the largest refractor telescope.

http://astro.uchicago.edu/vtour/defn.html
This Yerkes Observatory site offers helpful explanations of the differences between refractor and reflector telescopes.

http://galileo.rice.edu/sci/instruments/telescope.html
Rice University provides information about the history of the telescope.

http://hou.lbl.gov/~vhoette/Explorations/OpticalPowers/1-telescope-pictures.html
This site provides many pictures of the telescopes available at The University of Chicago Yerkes Observatory.

http://seds.lpl.arizona.edu/billa/psc/hist2.html
This section of *Important Astronomers, Their Instruments, and Discoveries* focuses on the history of the early refracting telescopes.

http://www.astronomynotes.com/telescop/s2.htm
This site provides a design diagram as well as lists the advantages and disadvantages of refractor telescopes.

http://www.astronomynotes.com/telescop/s3.htm
This site provides a design diagram as well as lists the advantages and disadvantages of reflector telescopes.

http://www.detroitobservatory.umich.edu/Telescopes.html
The University of Michigan Detroit Observatory provides information and pictures of various telescopes throughout history.

http://www-gap.dcs.st-and.ac.uk/~history/Mathematicians/Galileo.html
More information about Galileo, his family, and his work.

Print Resources

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McSween, H.Y. (1999). *Meteorites and their parent planets***.** Cambridge; NY: Cambridge University Press.

Peebles, C. (2000). *Asteroids: A history*. Washington, DC: Smithsonian Institution Press.

Roth, G.D. (1962). *The system of minor planet*. Princeton, NJ: Company Inc.

Schorn, R.A. (1988). *Planetary astronomy*. College Station, TX: Texas A&M University Press.